# Renewable Radio Power- Implementation Update

Minimizing IHC AA Battery Use

**Co-Authored by:**
Andrew Tanner, Matt Hoggard, Jim Shepherd

**Description of the Project**:
Mount solar panels on the Black Mountain Interagency Hotshot Crew Vehicles to demonstrate feasibility of using rechargeable batteries during operational periods and to reduce usage of disposable AA batteries. For a full technical description please refer to the proposal document.

Hotshots are extremely mobile crews that use their vehicles as a home base they do not have the luxury of being able to drop a battery into a wall charger each night in order to avoid using disposable batteries. We have designed a system that will allow them to use rechargeable batteries to power their radios as well as provide other safety and waste reduction benefits. The system will pay for itself in only one season using rechargeable batteries versus the cost of AA batteries.

**Implementation Process:**
Procurement of the solar panels and installation was accomplished prior to the Hotshots leaving for their first off forest tour. Jim Shepherd supervised the installation of the charge controllers and the solar panels with the assistance of several of the permanent hotshots. The mounts for the panels were fabricated to prevent overheating the panels and shortening their lifespan as they are mounted just above the AC units over the cab (see photo1 and 2). The solar panels procured provide a rated 40 watts at 12v to the main vehicle batteries through a charge controller whenever there is full or partial sunlight. The Hotshots reported that this part of the system has worked flawlessly for the entire summer.

There were several setbacks with the chargers in procurement and function. We received one of the 12 volt, 6 bay, gang chargers for the radio batteries, quite quickly after contacting RELM wireless (see photo 4). They informed us that this was a unit not available to the general public as it is still in engineering development (this may have changed in the intervening year). We tested the unit thoroughly in the radio shop for off line power drain and also for charging draw before install. The unit seemed to perform well, so we proceeded with the install in the crew vehicle and the order of the second gang charger. Several weeks after the install the Hotshots reported multiple fuse failures seeming to originate with the radio battery charger. Upon investigation it was found that the strain relief on the 12v power cord for the RELM charger was not sufficient and had caused a short in the cable (see photo 5). Jim Shepherd fixed the short and designed an improved strain relief that has worked well for the rest of the season and eliminated the fuse failures (see photo 6). We provided feedback to RELM Sales on this strain relief problem, but are following up with their R&D department (pictures etc.) to make sure they rectify the problem before production.

The most significant setback in full implementation of the project was the long delay between ordering and receiving the second 12v radio battery gang charger. The order was placed in April and the unit was not received until around the 15th of September. There seems to have been some communication breakdown between our verbal order and several follow up emails with the RELM Sales Department and getting the unit built, tested and shipped to us by their Research and Development Department. Once received the charger it was installed on the second crew vehicle to complete implementation.

**Costs to date:**
The following are the expenditures

- $1029.60 Two 12v six bay radio battery gang chargers
- $492.80 Two 40W solar panels
- $83.00 Two 12v solar panel charge controllers
- H-T contribution
    - 8 hours of install time and 2 hours admin time
    - 10 rechargeable radio batteries

**Benefits realized to date/ projected benefits:**
The crew members on the Black Mountain Hotshots report that they have been using rechargeable batteries. They have not been able to fully make the switch because of being short one 12V gang charger. The second charger was delivered late in the fire season so now they can start next year's season using rechargeable batteries nearly exclusively. There was also a problem for a portion of the season with the first charger. The strain relief on the power supply cord was not sufficient, resulting in a short in the cord and blown fuses. With some diagnostics the problem was found and corrected in house at the H-T radio shop. The insufficient strain relief was reinforced with a heavy duty solution with hot-glue and heat shrink (see photo 6). This solution seems to have work very well and when the second unit came in we preempted the problem before sending the charger unit out to the field.

The hotshot crew expressed interest in the possibility of using lighter weight, longer lasting and smaller lithium batteries that have become available. These batteries also have the benefit of no memory effects from charging at any phase of use. As the prices come down this battery technology would be ideal for the fast-and-light nature of Hotshot operations (see photo 3). These batteries weigh one third less than the AA clamshells that all hotshots have been carrying to date. Another of the other great benefits of this type of battery is the dramatically increased battery life. One 3800mAh lithium battery could last for up to two weeks based on average usage and about a week on heavy usage! I believe that Black Mountain will be trying out several of these batteries this year. Before this solution even evaluating the batteries was not possible.

One other benefit that has been seen is the system's capability to maintain the charge on the crew vehicles main batteries. Each vehicle has multiple deep-cycle heavy duty batteries for starting the engines and running the onboard equipment. Like any vehicle these batteries are normally charged with the engine driving an alternator which produces the DC voltage that is required. When the vehicles don't run for a significant period of

time… as in the off season there is a possibility of discharging these main batteries fully and ruining their capacity to hold a charge. The source of this discharge is the myriad of small electronics and computers included in all modern vehicles that draw a slight charge whether the vehicle is operating or not. Upon receiving from the manufacturer the crew vehicle they had this problem with their main batteries, i.e. they were inoperable. As I understand it during the time that the vehicles sat for their first winter they also had battery problems. Since the vehicles have been fitted with our solar system that maintains the batteries there has been no further trouble. In fact this spring as they were taken out of mothballs they fired right up. This result in and of itself gives a large environmental benefit, (not having to dispose of those large lead acid batteries). This technology also provides another margin of safety for the crews since the vehicle batteries are kept always at an optimal charge with solar energy even if they are away from their vehicles for multiple days.

One of the things that we haven't been able to accomplish is dissemination of our project by MTDC Tech Tips. We have not heard back from them even though we made a submission during their annual call for projects. We have and are following up with other contacts in the "Greening the Forest Service" movement to try and get some publication of the project. Even though we have not been able to get published, word of mouth in the Hotshot community is heating up. We have responded to five or six requests for descriptions of the project and suspect that many more Shot crews will be interested this year as they see our solar panels and talk to those who know about the project.

One of the possible improvements to this system to improve it's portability to other mobile firefighting platforms is creating several sizes of 12V gang chargers. Engines of a variety of sizes that carry three to five firefighters could use a 2 and/or 4 bay variant of our gang charger. Also the Hotshot Superintendent or similar vehicles that carry several passengers could use a 2 bay gang charger. There is currently on the market a single bay 12V charger for mobile applications for vehicles and crews that only need that functionality. Also a variety of solar panels are available for these various applications which are relatively inexpensive and would provide all of the functionality described in our application to Hotshot crew vehicles. Another improvement for reducing the impact of alkaline AA waste is to think about switching the "backup" clamshell to long-life, long-storage, and lightweight lithium AA's that are readily available in the consumer market. These batteries, when used as a back-up could last for a whole season or even longer and reduce the need to throw away so many alkaline AA's.

Many thanks to the Region 4 "Green Micro Gant" team who evaluated our project and felt it merited funding. We hope these results will spur a change in the firefighting radio users to try out using rechargeable batteries both at their home units and on incidents. There is significant trepidation by some to make the switch, but it is easier on the environment and… you can always carry a back-up clamshell with AA batteries.

# Photos:

**Photo 1**- AC unit on cab pre-install

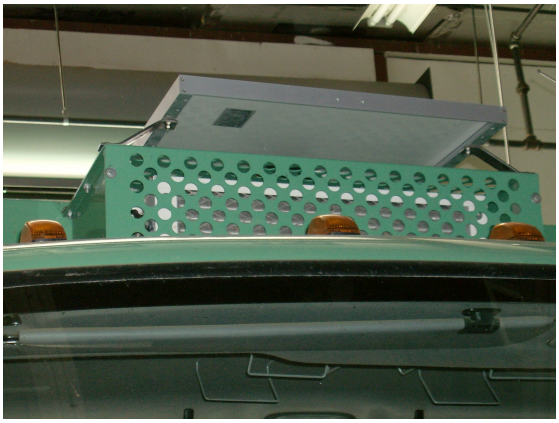

**Photo 2**- Installed Solar panel


**Photo 3**- AA's vs. Rechargeable batteries

**Photo 4**- 12V 6 bay gang charger with radio


**Photo 5**- Charger installed.

**Photo 6**- Improved strain relief

Note the strain on power cord. We would suggest even a 90º strain relief for ease of use and to make the unit more compact.